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Joint Direct Attack Munition

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ACQUISITION REFORM — INSIDE THE SILVER BULLET *A COMPARATIVE ANALYSIS — JDAM VERSUS F-22*

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Over the past quarter century, numerous acquisition reform initiatives have been implemented in an effort to extract greater effectiveness and efficiency from the federal acquisition system. Interestingly, while such initiatives have made a positive difference, uniformly positive results have not been achieved across the board. And in some cases, the relentless search for a “silver bullet” has detracted from the real work that successful change entails. Acquisition success stories abound, leading many to believe that acquisition reform is the key to program success. This paper compares the acquisition reform experiences of two Air Force programs to assess the validity of this assumption.

Is it reasonable to expect acquisition reform initiatives, proven successful on one program, to be equally effective on another? Or, are program outcomes dependent not only on the methods employed but also on the nature of the program and/or the environment within which it is executed? Historically, program outcomes, particularly in the systems acquisition arena, have been heavily influenced not only by the construct and management of that particular program, but also by decisions arising from the confluence of broader stakeholder, i.e., warfighters,

policymakers, politicians, and industry interests. Yet, although it is recognized that the nature of a program and the environment within which it is executed contributes to program outcomes, the emphasis over the past quarter century has been to search for a process-oriented silver bullet, i.e., acquisition reform initiatives that could, in and of themselves, eliminate real or perceived inefficiencies in the federal acquisition process.

Recent U. S. Air Force (USAF) experience indicates that while such initiatives make a positive difference, uniformly

positive results cannot be expected across the board. To illustrate, this article compares two very different, high profile, Air Force programs: The Joint Direct Attack Munitions (JDAM) program, under cost, under schedule, wartime top performer, acquisition streamlined to the maximum extent; and the F-22 program, over cost, over schedule, performance still in some doubt, acquisition streamlined to the extent feasible.

JDAM

JDAM provides the U.S. Air Force, U.S. Navy (USN), and allied forces with a precision aerial delivery capability for existing warheads. This improved capability is provided through a strap-on inertial guidance kit, which receives guidance updates from the Global Positioning System (GPS).

Following Desert Storm, the Air Force and Navy each initiated programs to develop this capability. These efforts were

subsequently merged in 1991 to form the JDAM System Program Office (SPO), with the Air Force designated the lead agency. The JDAM SPO initially functioned in a traditional manner, aligned within a functional organizational structure, utilizing standard

acquisition procedures. Although initial unit cost estimates had been as high as \$68,000, by early 1993 it had been determined that the average unit procurement price for the first 40,000 units was

not to exceed \$40,000 (FY91\$) (Ingols, 1998).

The program manager recognized that even though JDAM development was not technologically challenging, keeping the production kit price below \$40,000 was unlikely to occur absent radical change. He, therefore, sought and obtained authorization to conduct business in a more commercial-like manner (Ingols, 1998). The award of 18-month contracts for Engineering and Manufacturing Development (EMD) Phase 1 to Martin Marietta and McDonnell Douglas on April 11, 1994 was unaffected. Coincidentally, 11 days later, the Office of the Secretary of Defense designated JDAM one of five Congressionally-mandated Defense Acquisition Pilot Programs (DAPP).

JDAM's acquisition strategy called for a two-phased EMD approach followed by Low Rate Initial Production (LRIP) and then Full Rate Production (FRP). EMD-1, focused on reducing manufacturing risks and affordability, was a traditional contract, competitively awarded but later restructured to take advantage of opportunities afforded under the Department of Defense's (DoD) DAPP. EMD-2, an option under the EMD-1 contract, focused on developmental testing, preparations for production, and initial operational testing. A competitive down-selection was held and award made under the terms of McDonnell Douglas' EMD-1 contract. Subsequent production contracts were awarded on a single-source basis under the auspices of JDAM's DAPP authority (G. Williams, interview, March 2002).

In 1994, there was little precedent for doing business in a commercial-like manner. Therefore, to determine how best to

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acquire a military-unique system in a commercial-like manner, the JDAM SPO benchmarked and then implemented the best practices from industry (G. Williams, interview, March 2002).

- Performance-based requirements; no mandatory specifications and standards.
- Limited number of key performance parameters, one of which was low cost.
- Emphasis on price/performance trade-offs (Cost as an Independent Variable)
- Streamlined oversight (contractor and program office).
- Open and trusting relationships between the program office and industry counterparts; multiple integrated Government/contractor teams.
- Concise (two page) Statement of Objectives.
- Lean manufacturing.
- Configuration control maintained by contractor.
- Extensive reliance on commercial products.
- Commercial-like lifetime warranty (20-year shelf life, 5-year service life).
- Source selection award criteria based on past performance and best value.
 - Competitive down selection from EMD-1 to EMD-2 .

- Candid feedback provided to each competitor after each of three evaluation periods.
- Emphasis on price versus cost; award based, in large part, on Average.
- Unit Production Price.

- Opportunity for a long-term commitment.

The SPO's unrelenting focus on affordability coupled with the opportunity to use commercial parts and processes enabled both competing contractors to "submit proposals that were less than half the original cost target of \$40,000" per kit (Ingols, 1998). Affordability was addressed through the inclusion of an Average Unit Procurement Price (AUPP) for the first 40,000 production units and Production Price Commitment Curves (PPCC) for future production lots. Although price commitments for production Lots 6 and beyond were not contractually binding, the contractor was motivated to honor them.

By the end of EMD-1, each of the competing contractors had conducted a Critical Design Review (CDR), an initial Production Readiness Review, and a technical demonstration to verify physical fit and system functionality. Initial product design was essentially complete (90 percent of the drawings were final, while the remaining 10 percent were mature drafts). Source Selection criteria for EMD-2 addressed

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affordability and contractor performance, of equal importance, followed by system performance. The Air Force awarded McDonnell Douglas the option for EMD-2 plus options for production Lots 1 and 2 on October 11, 1995. The PPCC successfully motivated the contractor to achieve the Average Unit Procurement Price for Lots 1–5 and there is no evidence that this incentive will not continue to motivate desired behaviors (G. Williams, personal communications, March 2002).

However, transition from a competitive to non-competitive environment, while not substantively altering the Integrated Product Team (IPT) structure, did necessarily engender a more traditional relationship between the Government and its industry partner as each sought to effectively man-

age the JDAM program (Ingols, 1998). The decision to maintain the IPT structure proved fortuitous when in late 1997, the developmental and operational test programs and the production program all had to be restructured. Flight instability problems

with the Mk-83 and BLU-109 JDAM kits delayed production of BLU-109 by almost a year. Also part of the production restructuring was a decision to continue the development of the fin-locking mechanism needed to qualify the Mk-84 for the F/A-18 inboard pylons (G. Williams, personal communications, March 2002). Issues such as these, however, are to be expected as JDAM continues to be adapted for use with other munitions and platforms.

As a Defense Acquisition Pilot Program, JDAM was provided legislative

authority to implement provisions of the Federal Acquisition Streamlining Act (FASA) of 1994 and granted authority to use commercial item exemptions for non-commercial items. The JDAM SPO also benefited from expedited deviation authority from the Federal Acquisition Regulation (FAR)/Defense Federal Acquisition Regulation Supplement (DFARS) and DoD 5000-Series regulations. This relief allowed the JDAM team to renegotiate EMD-1 to make it more “commercial-like” and to streamline the milestone review process and reporting procedures. In all, the program received 28 waivers to FAR, 27 waivers to DFARS, and almost a blanket waiver to the DoD 5000-series regulations (G. Williams, personal communications, March 2002).

The buy-to-budget policy, approved in the Milestone II Acquisition Decision Memorandum, effectively fenced JDAM procurement budgets, allowing the program manager to funnel acquisition reform savings into increased annual procurements. While procurement budgets have not remained fixed, the program has enjoyed significant support and stability in the DoD, USAF, and USN budget process. As a result of not only the buy-to-budget policy but also the tremendous success of JDAM in combat, program stability has been maintained and production quantities have been substantially increased (G. Williams, personal communications, March 2002).

Innovative, commercial-like management at a critical stage coupled with the non-developmental nature of JDAM enabled a 33 percent reduction of the estimated development cycle, a 42 percent reduction in the estimated development cost, and more than a 50 percent reduction in

“Rigid strategic planning methods have proven inadequate for the high complexity and dynamics of large public acquisition projects.”

the average unit production price (Ingols, 1998). More important, the JDAM program produced an end product that met warfighter needs, on time, at an affordable cost. During Operation Allied Force, March 29 through June 9, 1999, B-2s launched 651 JDAMs with 96 percent reliability and hit 87 percent of intended targets, at a cost far below that of any other precision-guided munitions in the U.S. inventory (Ingols, 1998).

F-22

The F-22, originally identified as the Advanced Tactical Fighter (ATF), is the Air Force's next generation air superiority fighter. The F-22's design blends low observability with advanced avionics, a highly maneuverable airframe, and a new engine capable of sustained supersonic flight without afterburners. Other key elements include reliability, maintainability, and supportability requirements that reduce life cycle cost, enhance sustainment, and assure operational capability.

The F-22 program is managed within the traditional framework of DoD's acquisition management system and has enjoyed neither program stability nor limited oversight. In 1985, the Air Force planned to procure 750 aircraft at a rate of 72 aircraft per year between 1992 and 2005. By 1991, changes in the post-Cold War National Security environment prompted a reduction in quantity to 648, a reduction in the production rate from 72 to 48 per year, and a four-year delay in production. Following the award of EMD, these trends have continued, prompting five program restructures. To address burgeoning costs and affordability concerns

attributable to these changes as well as those resulting from developmental delays, the F-22 team implemented a number of cost reduction initiatives. Reporting and oversight requirements were also substantively increased (Druyun, 2001).

Yet, acquisition reform was embedded in this program almost from the outset. At about the same time that the Air Force was selecting two contractors to build competing prototypes, the Packard Commission was making its recommendations. Among these were that major weapons system acquisitions should utilize performance-based specifications and competitive prototype development and that Government and industry partners should share research and development costs.

The ATF program director, charged with implementing these recommendations, reorganized the F-22 SPO into government/contractor IPTs in order to enhance communication and cooperation and reduce program risk. The program office then worked with the two competing contractors to integrate the Packard Commission's recommendations as well as a few innovative ideas of their own, e.g., allowing competitors to design their own prototype test programs into the ATF Demonstration/Validation (Dem/Val) Program.

The results of these efforts were outstanding. Lockheed's YF-22 and Northrop's YF-23 were flight tested in late 1990, within four years of the award of their Dem/Val contracts, as compared to the Air Force's last stealthy aircraft program, the B-2, which took eight years

"In marshalling resources, risk management aggregates risks to assess their impacts and thereby estimate slack resource requirements."

from design to flight. The taxpayer cost for the ATF program was \$3.9 billion versus \$33.2 billion for the B-2. Granted, these are not absolute comparisons. The ATF benefited not only from taxpayer funding but also from industry investments totaling approximately \$2 billion,

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it also profited from what the Air Force had learned during earlier stealth programs, and the ATF cost cited above does not include production equipment that is embedded in the B-2 cost. Even so, it is clear that the ATF program achieved at least an order of magnitude im-

provement over the experience of the B-2 (Easterbrook, 1991).

However, this success was short-lived. Following the August 1991 award of the EMD contract to Lockheed Martin, funding shortfalls, technical difficulties, and threat changes necessitated five EMD program restructures, substantively increasing estimated acquisition costs, delaying Initial Operating Capability (IOC), and further reducing the number of production aircraft.

Although cost and affordability were important from the outset, they became critical priorities following the award of the EMD contract. In June 1996, a Joint Estimating Team (JET) developed the most probable F-22 production cost and identified initiatives to reduce that cost. Leveraging JET recommendations, the Air Force and contractor teams initiated a comprehensive cost reduction program in February 1997. It included a Target Price Curve (TPC) for LRIP that achieves the

desired F-22 AUPP and an Affordability Improvement Program (AIP) for follow-on production contracts. Other Production Cost Reduction Plans (PCRP) included:

- Producibility improvement projects.
- Lean manufacturing.
- Leveraged buying strategies to lower cost of raw materials and purchased parts.
- Production support tailoring.
- Performance based contracting.
- Multi-year procurement.
- Rate savings due to award of the Joint Strike Fighter contract.

Although significant challenges remain, progress is being made as evidenced by the passage of yet another major milestone in August 2001, when the Defense Acquisition Board unanimously approved the F-22's entry into LRIP.

COMPARATIVE RESULTS

JDAM is clearly a success story. The question is, to what degree are its results replicable. No doubt, the program benefited from visionary leadership, effective management, sustained commitment to affordability, a competitive environment, regulatory relief, limited oversight, and a relatively stable budget environment. But it also benefited from other opportunities.

While JDAM is a military-unique system, the technologies required to build it

were, to a large extent, both mature and commercially available. These include the inertial measurement unit, GPS receiver, mission computer, and control actuators, which together account for approximately 85 percent of the system hardware cost (Joint Direct Attack Munitions [JDAM], 1997).

Additionally, many of the other components (wings, wiring harnesses, and metal structures) rely on manufacturing processes that are amenable to manufacture using commercial processes and dual-use processing equipment (JDAM, 1997). While a number of efficiencies were realized, the most significant was the price decrease resulting from the reduction in size and cost of the GPS receiver. McDonnell Douglas was also motivated. Having recently lost a major competition for sole production of the Tomahawk missile, they realized that if they wanted to remain in the precision-guided munitions business, they had to win JDAM (Ingols, 1998).

As with the JDAM program, acquisition reform initiatives implemented by the F-22 program during the competitive phase garnered extraordinary results while those applied in a noncompetitive environment proved to be less effective. This result should not be surprising, given that competition has long been recognized as one of the market's most effective cost containment strategies. The fact that competition could be sustained through EMD-1 for JDAM proved fortuitous in reining in cost through the commitment to Average Unit Procurement Prices and Production Price Commitment Curves under competitive conditions. The F-22 was not afforded this opportunity — for while sustenance of competition is a worthwhile

goal, competition beyond Dem/Val is generally not feasible for major weapons systems. Even on JDAM, it was recognized that it was too costly a process to maintain beyond EMD-1 (Lovell, 2001).

Program stability and management oversight also played significant roles in the effective and efficient execution of these programs. JDAM benefited from fairly stable budget authority and minimal program oversight. F-22 execution, on the other hand, was and continues to be greatly hampered by budget instability exacerbated by requirements changes and developmental delays, prompting even greater levels of program scrutiny. It should be noted, however, that as the USAF's largest acquisition program, the F-22 program, under the best of circumstances, could not have avoided

much of the intense scrutiny under which it has operated since its inception. And as threats began to change, developmental challenges arose, and total ownership costs continued to mount, it was unlikely to be overlooked as a prime source of funding for other "must-pay" bills.

While JDAM was well positioned to take advantage of the opportunity to do business in a commercial-like manner, the F-22 was only marginally afforded this opportunity. Although these programs span the spectrum of typical military development efforts, neither would have met the criteria for a typical commercial development program. Commercial product launches generally require a match between customer requirements and available technology; evidence that the design is mature prior to commitment; and proof

"JDAM benefited from fairly stable budget authority and minimal program oversight."

that the product is producible within cost, schedule, and quality targets prior to production. This increased knowledge, available to industry decision makers at critical junctures, mitigates the potential for cost escalation, requirements changes, and schedule delays (Schinasi, 2000).

Militarily unique development programs are also riskier than commercial programs because, in addition to pushing the state of technology, they require tight cost and schedule estimates up front. This

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was certainly true for the F-22 program, dependent on a number of significant technological advances in integrated avionics, sustained supersonic flight, and low observability. But it was less so for the JDAM program due to its dependence upon a combination of commercial and non-developmental rather than emerging technologies.

Perhaps too, we expect too much of complex military development programs. For it is instructive to note that while the F-22, the USAF's next generation air superiority fighter, took 14 years to move from concept development to first flight, commercial development of the Boeing 767, an aircraft built upon proven rather than emerging technologies, consumed, not four as originally projected, but 12 years (from concept development to first flight) (The Boeing 767, 1991).

CONCLUSIONS

While both the JDAM SPO and the F-22 SPO sought to do business in a more commercial-like manner, it is not clear that the results of such efforts can or should be expected to be equally effective from one program to another. Although acquisition reform initiatives enhanced program outcomes in both cases, they were not the principal determinant of program outcomes nor did the application of specific acquisition initiatives necessarily produce like outcomes. JDAM's success is largely attributed to the program's effective implementation of acquisition reform initiatives, yet the facts indicate that while these initiatives enhanced program outcomes, there were many other contributing factors, not the least of which was the program's ability to sustain competition through EMD-1.

Nor did application of like initiatives necessarily yield similar results, e.g., JDAM's inclusion of an AUPP under competitive conditions proved much more effective than did the F-22's inclusion of a similar provision under noncompetitive conditions. Rather, program outcomes were dependent upon not only the construct and management of the program, but also the confluence of broader stakeholder, i.e., warfighters, policymakers, politicians, and industry interests.

Acquisition reform initiatives, in and of themselves, however well conceived and intentioned, cannot be expected to remedy real and perceived inefficiencies in the federal acquisition process, in part because it is but a subset of a much larger, highly

complex, institutional system, i.e., our government (Brandt & A'Hearn, 1997). Acknowledging that federal acquisition is effected within this larger framework is critical to understanding acquisition reform

is not a silver bullet and why stakeholder interests must be factored into the acquisition change process if the effectiveness and efficiency of this system is to be materially enhanced.



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